

Distributed Computing for Near Earth Asteroids Research

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Distributed Computing for Near Earth Asteroids Research

- Motivation
- Distributed Computing (DC)
- Applications to NEAs research
- Our experience so far: real world DC

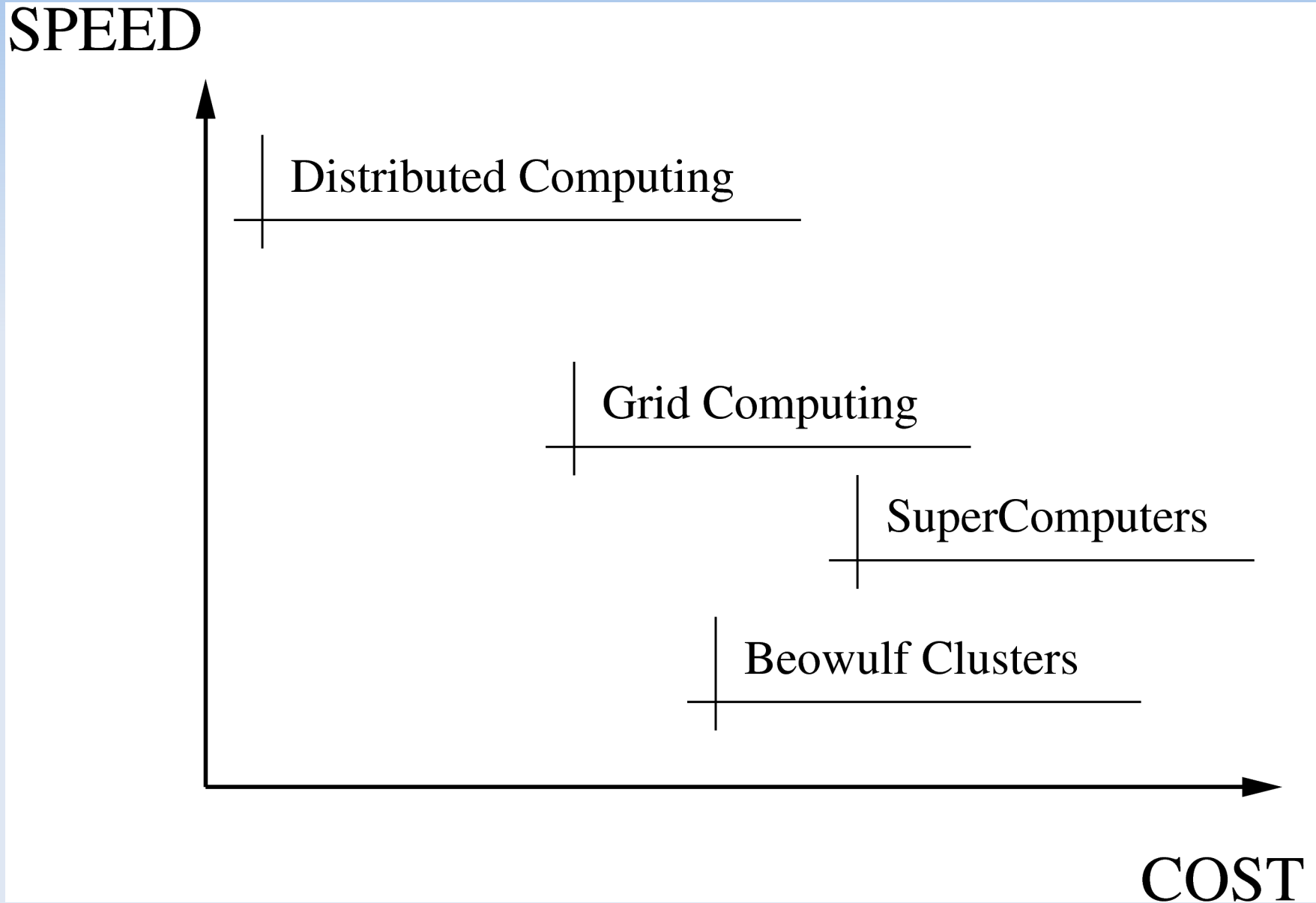
DC for NEAs: Motivation

- DC is an emerging technology, and offers virtually unlimited computational power
- DC can enable qualitatively new science, and our application is an example
- DC is successfully adopted by research teams working in Physics, Chemistry, Biology, Medicine, Earth Sciences, and Mathematics
- DC could become an important computational paradigm within NASA

DC Platform: BOINC

- BOINC: Berkeley Open Infrastructure for Network Computing
- State of the art DC implementation, free, open source, well supported
- Uses **idle CPU cycles** of volunteer computers
- After installation, no user action required
- Users motivated by credit system and rankings (no monetary value)
- Clients run as screensavers
- Subscribe to multiple projects

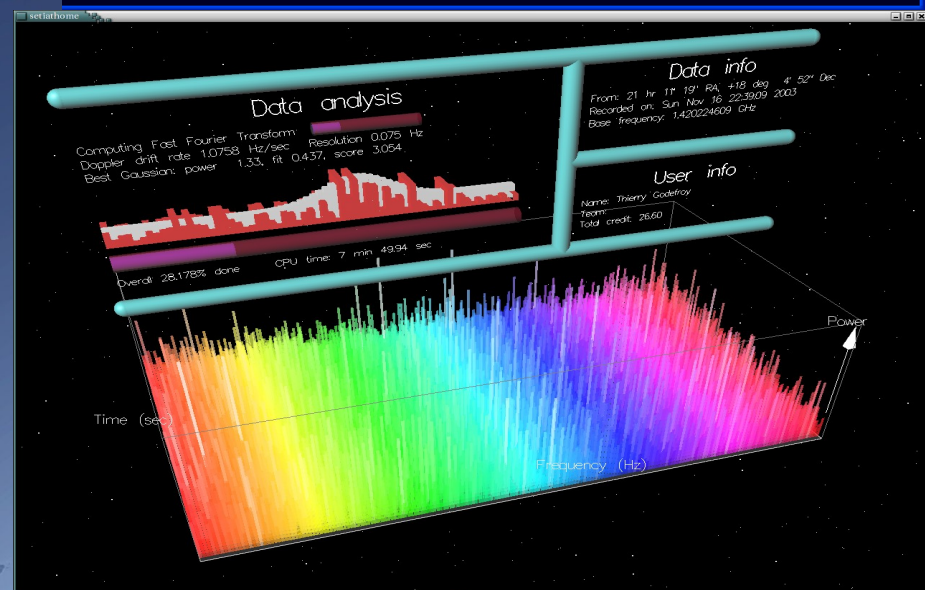
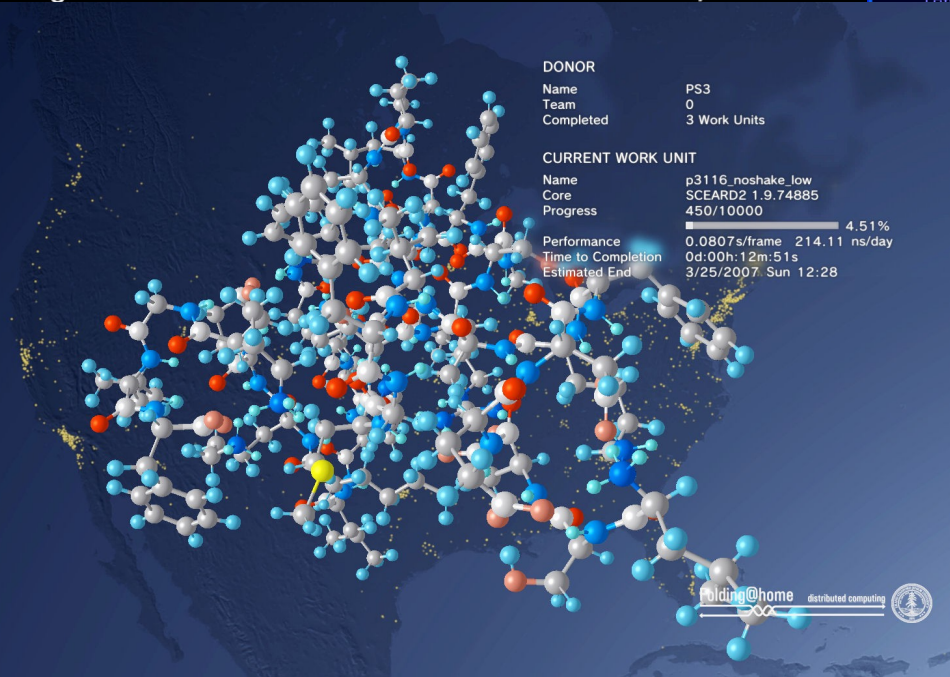
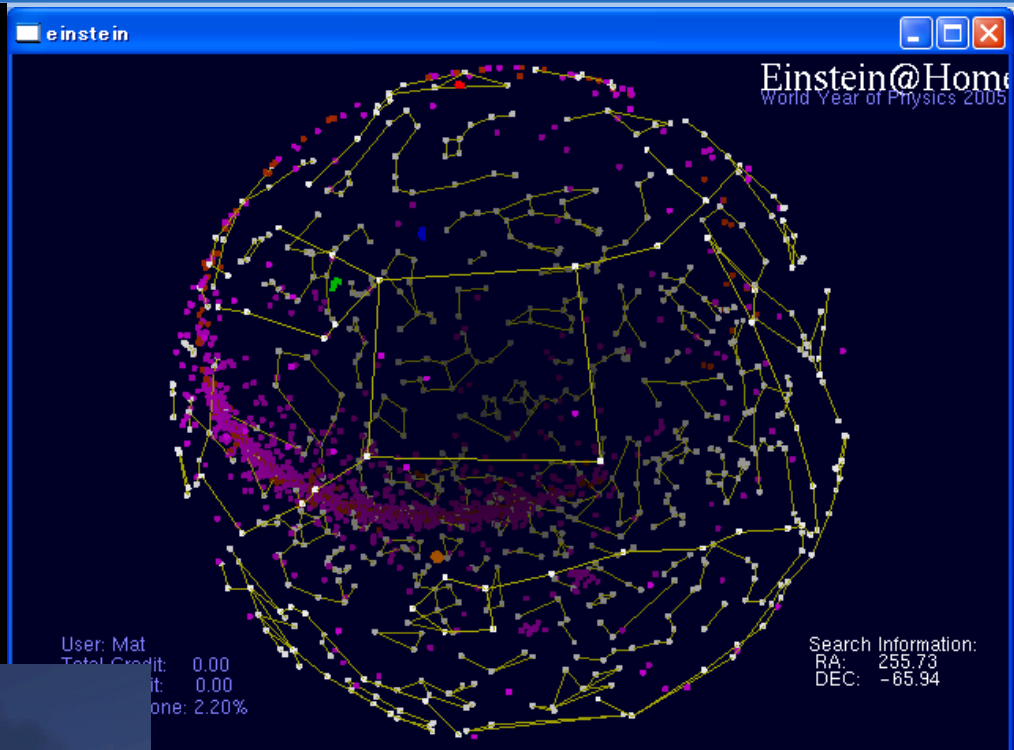
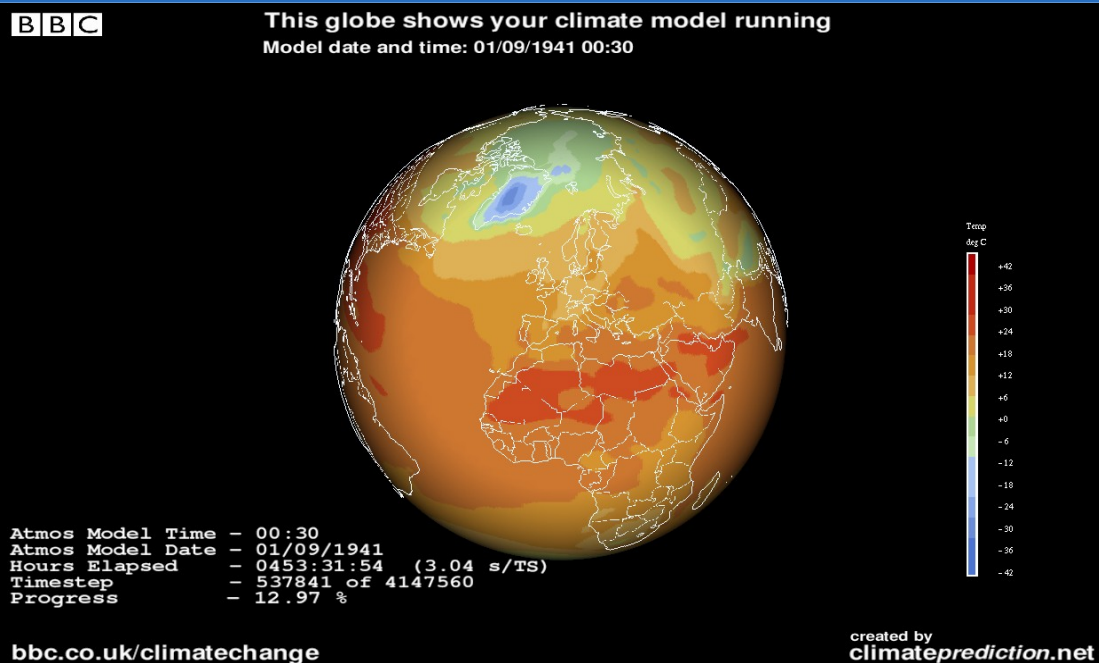
Computing Paradigms



DC Project Requirements

- Not all projects are good DC candidates
- Need high CPU/data ratio (data reuse helps)
- No communication between clients
- Jobs can be suspended/resumed
- Fault tolerance: hardware & software problems
- Public relations

Popular DC Projects



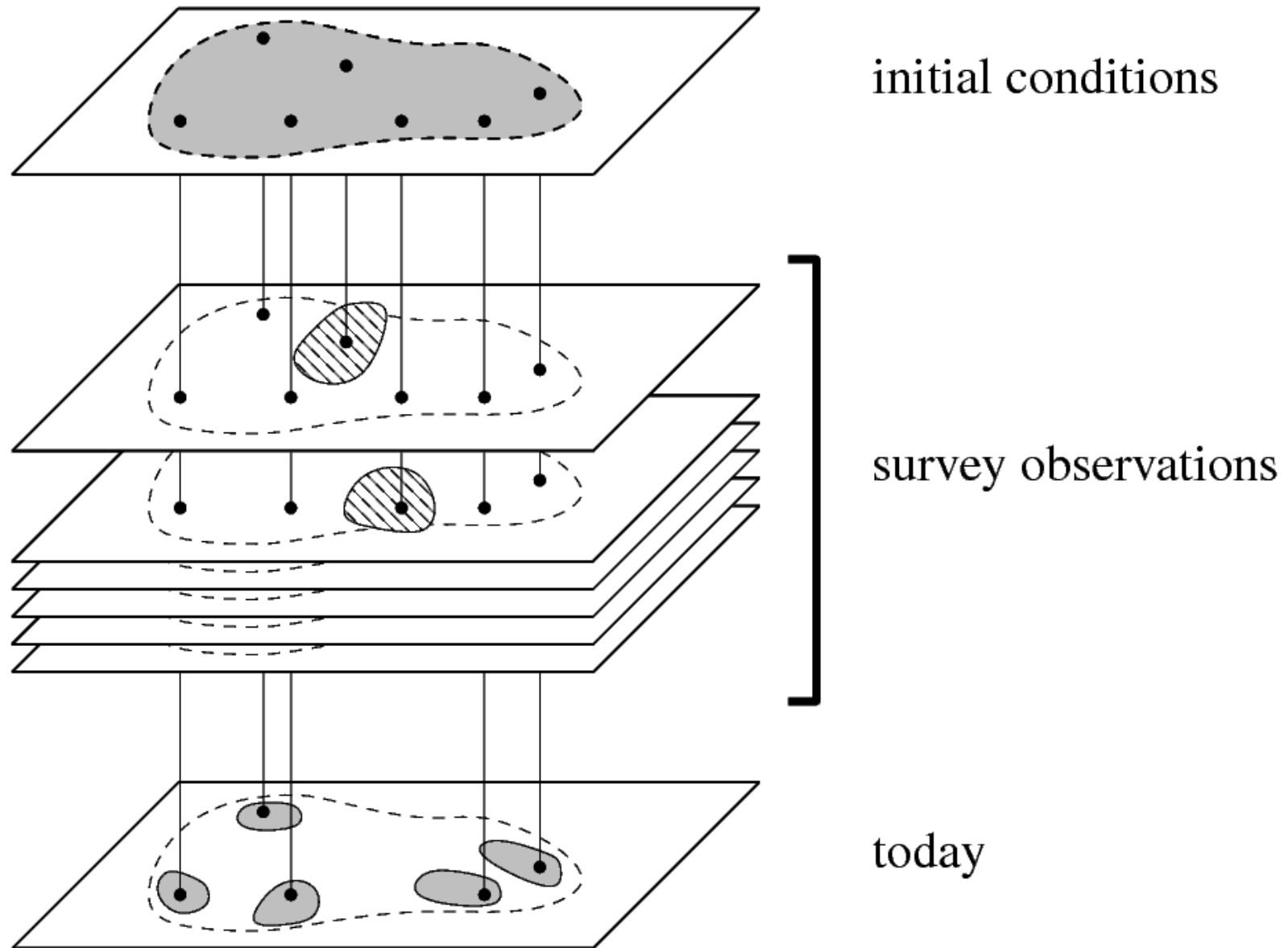
Advantages of DC

- Your software runs on ~10k to 1M clients
- ...need more?
- Screensaver is great for EPO
- Maintenance needed only on your server
- Volunteers in the public provide clients

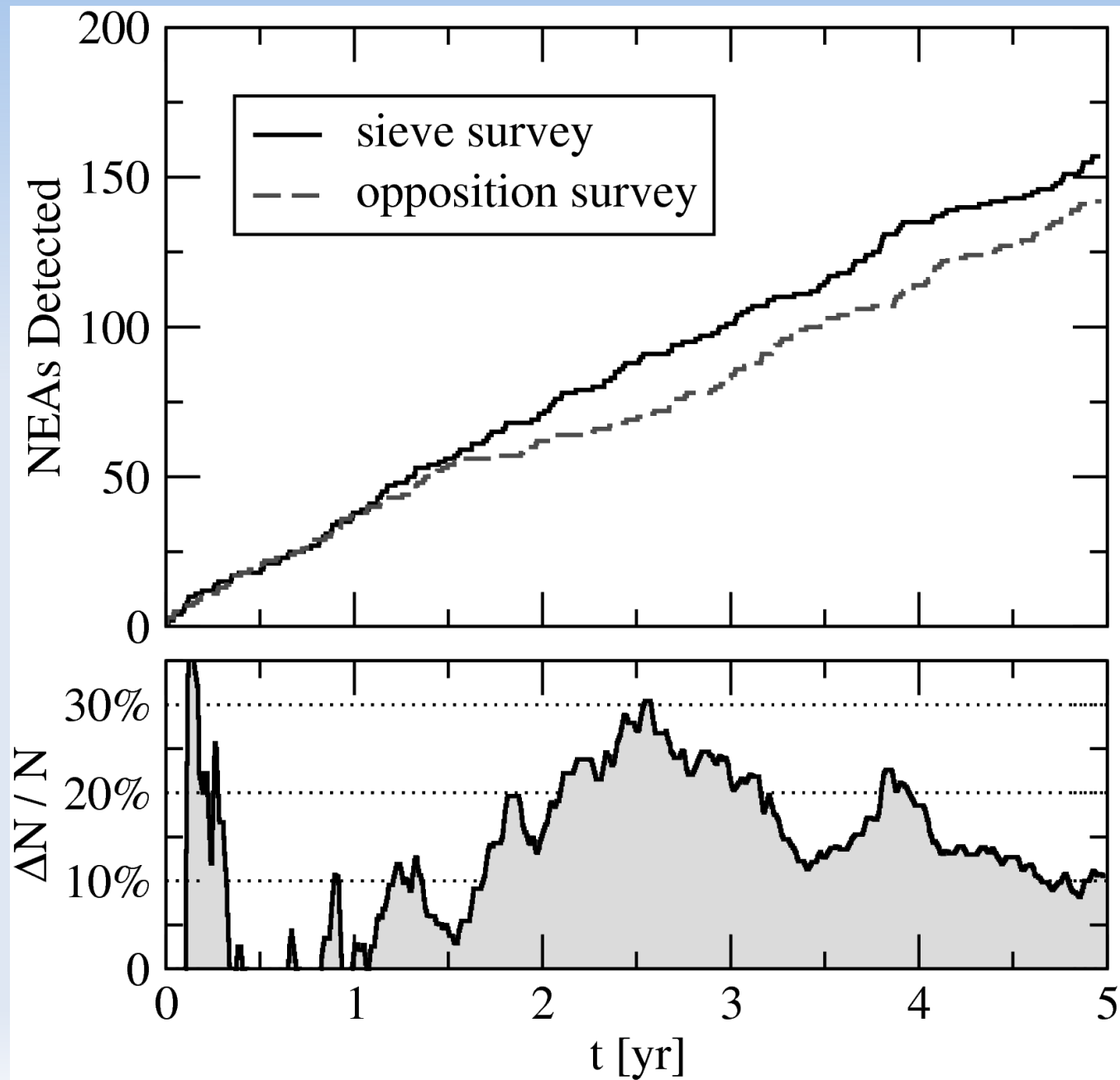
NEAs Research: Improving Survey Planning

- NASA NEA surveys scan the sky to discover new NEAs and rule out the possibility of an impact with the Earth
- Astronomers choose fields using a handful of basic principles, without the support of long-term simulations
- We try to improve this, including the long-term past performance of surveys to determine the sky fields where a discovery is most likely
- Our project: [orbit@home](#) (started March 2008)

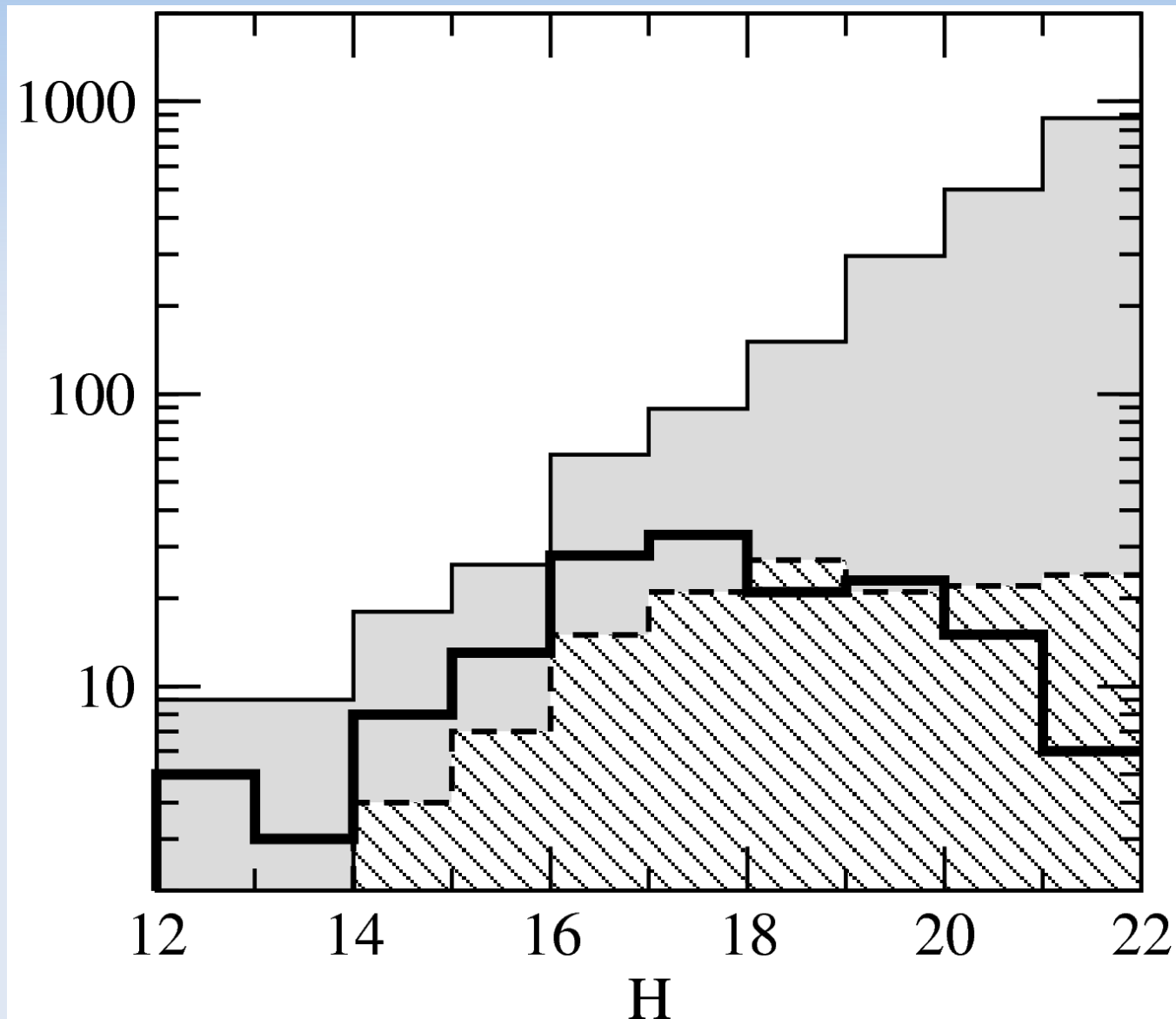
NEAs Survey Simulator



Performance: dN/N



Absolute Magnitude H



DC for NEAs Impact Hazard Monitoring

- We want to use [orbit@home](#) to investigate feasibility and responsiveness
- For each NEA, maintain updated orbit solution, and perform Monte Carlo simulations to estimate impact probabilities
- Possible challenges are in the wall clock **response time** and **cross-platform validation**

Real World DC Experience

- Users complain when their computer is not working for your project
- Not a problem to find experienced beta testers, that provide lots of great debugging support
- Writing your application for different platforms can actually improve your application

Conclusions

- DC is a mature technology
- If you have a project that fits DC requirements, you should seriously consider this option
- [orbit@home](#) opens the door to a series of Celestial Mechanics problems solved using DC